

WHAT IS CLAIMED IS:

1. A differential frequency doubler circuit, comprising:  
differential input terminals;  
differential output terminals;  
a frequency doubler module coupled between said differential input terminals and a first one of said differential output terminals; and  
a phase reversal module coupled between said frequency doubler module and a second one of said differential output terminals.
2. The apparatus according to claim 1, wherein said frequency doubler module receives a differential input signal and generates a first output signal having a frequency that is double a frequency of the differential input signal, and wherein said phase reversal module generates a second output signal that is substantially equal in amplitude and opposite in phase to the first output signal, wherein said first and second output signals form a differential output signal having the frequency that is double a frequency of the differential input signal.
3. The apparatus according to claim 2, wherein said differential output signal has a duty ratio that is substantially equal to a duty ratio of the input signal.
4. The apparatus according to claim 1, wherein said phase reversal module comprises a transistor including a gate terminal coupled to a fixed voltage and a source terminal having a source terminal voltage that varies with an output of said frequency doubler.
5. The apparatus according to claim 1, wherein said phase reversal module comprises a transistor including a source terminal coupled to a fixed voltage and a gate terminal having a gate terminal voltage that varies with an output of said frequency doubler.
6. The apparatus according to claim 1, further comprising:  
a DC bias module coupled between said frequency doubler module and said phase reversal module.

7. The apparatus according to claim 1, wherein said frequency doubler module comprises:

- a first NMOS transistor including a gate terminal coupled to a first one of said differential input terminals, a drain terminal coupled to said first one of said differential output terminals, and a source terminal; and

- a second NMOS transistor including a gate terminal coupled to a second one of said differential input terminals, a drain terminal coupled to said first one of said differential output terminals, and a source terminal coupled to said first NMOS source terminal;

- wherein said phase reversal module transistor comprises a third NMOS transistor including a drain terminal coupled to a second one of said differential output terminals, and a source terminal coupled to said source terminals of said first and second NMOS transistors, and a gate terminal coupled to said fixed voltage.

8. The apparatus according to claim 5, wherein said frequency doubler module comprises:

- a first NMOS transistor including a gate terminal coupled to a first one of said differential input terminals, a drain terminal coupled to said first one of said differential output terminals, and a source terminal; and

- a second NMOS transistor including a gate terminal coupled to a second one of said differential input terminals, a drain terminal coupled to said first one of said differential output terminals, and a source terminal coupled to said first NMOS source terminal;

- wherein said phase reversal module transistor comprises:

- a third NMOS transistor including a drain terminal coupled to a second one of said differential output terminals, a source terminal coupled to said source terminals of said first and second NMOS transistors, and a gate terminal;

- a differential amplifier including an output coupled to said gate terminal of said third NMOS transistor, said differential amplifier including a

negative input coupled to said source terminals of said first, second, and third NMOS transistors; and

a fourth NMOS transistor including a gate terminal coupled to said fixed voltage, and a source terminal coupled to a positive input of said differential amplifier.

9. The apparatus according to claim 7, wherein a width/length ratio of said third NMOS transistor is approximately double a width/length ratio of said first and second NMOS transistors.

10. The apparatus according to claim 8, wherein a width/length ratio of said third NMOS transistor is approximately double a width/length ratio of said first, second, and third NMOS transistors.

11. A method of differentially doubling a frequency, comprising:

- (1) receiving a differential signal having a first frequency;
- (2) generating a first output signal from the received differential signal, the first output signal having a frequency that is double the first frequency;

- (3) generating a second output signal from the first output signal, wherein the second output signal is substantially equal in amplitude and opposite in phase to the first output signal, wherein said first and second output signals form a differential output signal having a duty ratio that is substantially equal to a duty ratio of the received differential signal.

12. A method for controlling a transistor to generate a current that is opposite in phase to a reference current, comprising:

- coupling a gate terminal of the transistor to a fixed voltage;
- varying a source terminal of the transistor with the reference current;
- whereby the transistor generates a current that is substantially equal in amplitude and opposite in phase to the reference current.

13. A method for controlling a transistor to generate a current that is opposite in phase to a reference current, comprising:

- coupling a source terminal of the transistor to a fixed voltage;
- varying a gate terminal of the transistor with the reference current;

whereby the transistor generates a current that is substantially equal in amplitude and opposite in phase to the reference current.

14. The method according to claim 13, wherein the varying of the gate terminal comprises varying a gate terminal of the transistor under control of an operational amplifier in a feedback loop.